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South American Panurgine Bees (Apoidea: Andrenidae: Panurginae), Part I. Biology, Mature Larva, and Description of a New Genus and Species

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ABSTRACT

Parasarus Ruz, new genus, is described and illustrated. This genus of small, black, ground nesting panurgines is found in Chile and Catamarca Province, Argentina. It is based on ***P. atacamensis*** Ruz, new species (described herein), from northern Chile, and contains a number of other species, yet to be named. Biological information about *P. atacamensis* includes: pollen sources, nest architecture, provisioning, oviposition habits, egg description, larval defecation habits, and cuckoo bee parasitism. The mature larva is described taxonomically, illustrated, and compared with larvae of *Protandrena, Pseudopanurgus,* and *Pterosarus.*

RESUMEN

Se describe e ilustra un nuevo género de Panurginae, *Parasarus* Ruz. Las especies de este género son pequeñas, negras, anidan en el suelo y se encuentran en Chile y en la Provincia de Catamarca, Argentina. *Parasarus*, basado en *P. atacamensis* Ruz, n. sp. (especie que aquí se describe), se encuentra en el Norte de Chile, y contiene además varias otras especies que aún deben ser nominadas. Información biológica de *P. atacamensis* incluye: fuentes de polen, arquitectura de nido, aprovisionamiento, hábitos de oviposición, descripción del huevo, hábitos de defecación de la larva y abejas parásitas. La larva madura es descrita taxonómicamente, ilustrada y comparada con larvas de *Protandrena*, *Pseudopanurgus* y *Pterosarus*.

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INTRODUCTION

This is the first of a series of papers in which we shall describe and name new genera and subgenera of South American panurgine bees and provide information about their nesting behavior, ontogeny, floral preferences, and other aspects of their natural history. Where possible we will also describe their immature stages, especially the last-stage larva. Because the Panurginae tend to be small-bodied, they were generally overlooked by early workers who concentrated on collecting and describing larger South American bees. As a consequence much of the very rich panurgine fauna of that continent has yet to be studied. This paper deals with a panurgine genus that at this time contains perhaps three unnamed species, from Chile and Catamarca Province, Argentina. The commonest species and the one for which we have the mature larva and biological information is described herein and serves as the type of the genus; the other species await description.

Because there are many new genera and subgenera of panurgines to be described, the first efforts of the series will be to characterize these taxa and validate their names as information becomes available; therefore, the sequence of presenting taxa in the series does not necessarily imply relationships. We hope to analyze their phylogenetic relationships in a final paper of the series. Revisions of the genera identified in the present series will be undertaken separately. To do so now would be a prohibitively long task.

In this paper, the first author (LR) provides the descriptions of the genus and species based on adults, and the second author (JGR) contributes the sections on Biology and Mature Larva.

Specimens of immature stages and nest components are in the collection of the American Museum of Natural History. Deposition of adult specimens is treated below.

ACKNOWLEDGMENTS

Information about the ecology, behavior, and immatures of *Parasarus atacamensis* was collected on field trips supported by grants to JGR from the National Geographic Society (No. 3844-88) and from the National Science Foundation (GB5407). Drawings of adult structures were inked by Carmen Tobar, Universidad Católica of Valparaíso, Chile (UCV). Beatrice Brewester, American Museum of Natural History (AMNH), helped prepare the manuscript, and Eric Quinter (AMNH) assisted in editing it.

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SYSTEMATICS

In the following descriptions of adults, passages in italics indicate the most important diagnostic features. T and S refer to numbered metasomal terga and sterna (e.g., T5, S4). Fore, mid, and hind legs are numbered 1, 2, and 3, respectively. Measurements were made with an ocular micrometer in a Wild M5 stereomicroscope with a 25× objective. Ratios are expressed in units of the ocular micrometer: 25 units = 1 mm. Figures of male genitalia and associated sterna are oriented so that their bases point toward the bottom of the page and their apices toward the top. Collection data have been transcribed to correspond to the recent reorganization of the political regions and provinces of Chile; names in capital letters refer to regions, and specific localities are in italics.

PARASARUS Ruz, new genus

Figures 1–18

TYPE SPECIES: *Parasarus atacamensis* Ruz, new species.

DIAGNOSIS: *Parasarus* superficially resembles *Heterosarus* since both genera have a rather flattened face, slightly depressed lateral foveae on metasomal tergum 2 (T2), and rather short, thin, and apparently simple hairs on the tibial scopa. Nevertheless they can be easily separated because *Parasarus* shows no yellow on the face of the male, has sparse mesosomal punctation, and its metasoma is usually as wide as the mesosoma. Males of *Parasarus* with a wide head look like *Cephalurgus* males, but in *Cephalurgus* the supraclypeal area is distinctly swollen, the paraocular areas are clearly convex, the lateral foveae of T2 are well defined, and the genital

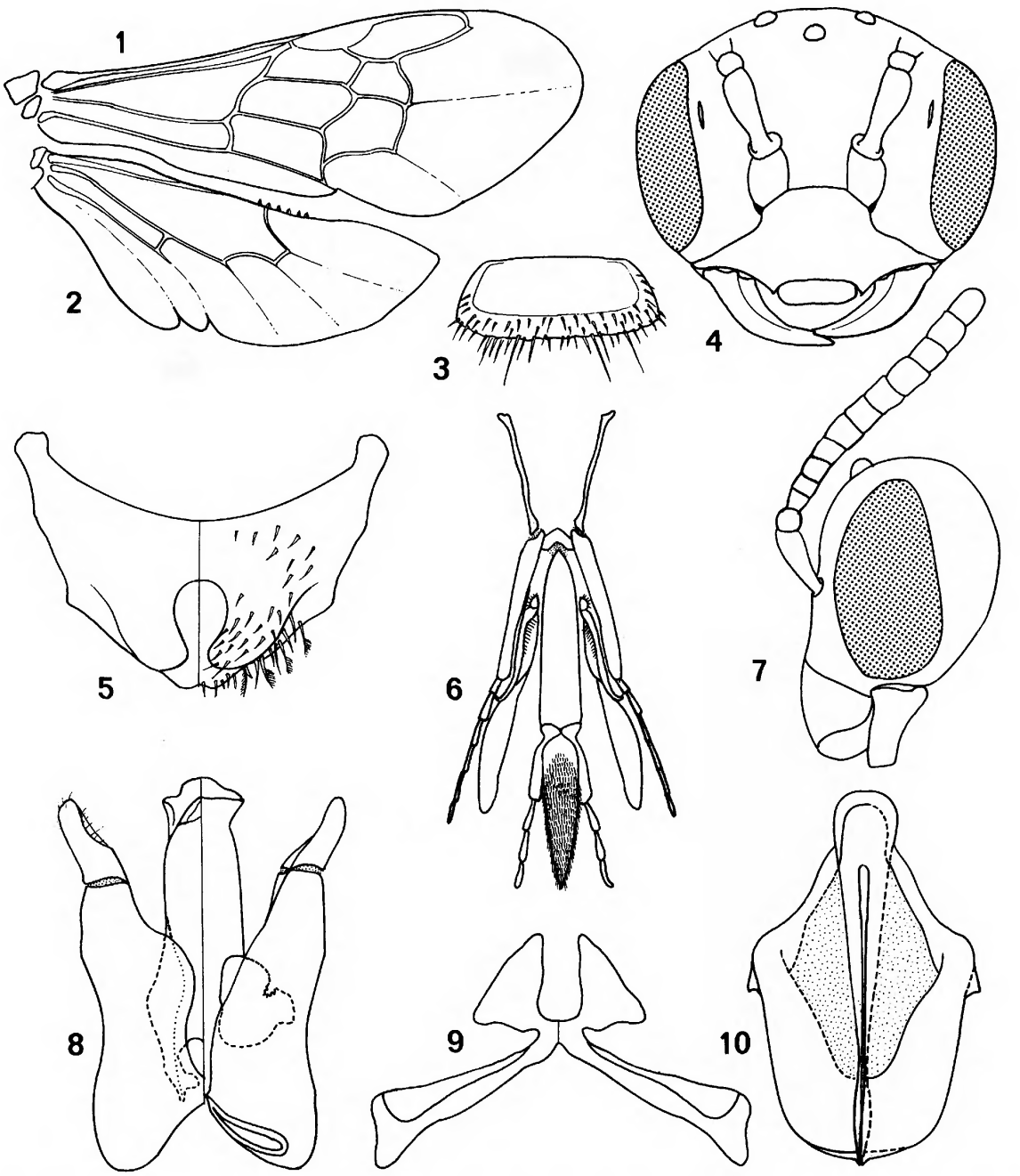
capsule has a small gonobase. *Parasarus* differs from *Heterosarus* and *Cephalurgus* as follows: subantennal area about as wide as length of inner subantennal suture, small tubercle present between antennal sockets, male genitalia and associated sterna as illustrated, and female tibial spurs distinctly curved apically.

DESCRIPTION: *Body small (3–5 mm), black or dark brown, with some yellow markings especially on legs. Pubescence in general short and whitish,* minute on most parts of metasomal terga, rather sparse although *usually denser on lower half of face.* Integument areolate but smooth in some undescribed species from Chile and Argentina. *Punctation in general fine*, sparse, usually dense on clypeus.

Head varying from narrower to wider than mesosoma. Mandible simple. *Glossa shorter than prementum* (much shorter in an undescribed Chilean species). *Segment 1 of labial palpus shorter than 2–4 together.* Maxillary palpus six-segmented. Galeal comb well developed (6–12 bristles) (fig. 6). Labrum (fig. 3) with basal part smooth, impunctate, usually delimited by ridge or carina; distal part usually flat, strongly reflexed (slightly convex in an undescribed species from Argentina). Tentorial pit in intersection between epistomal suture and outer subantennal suture (fig. 4). Antennal socket (fig. 4) just above middle of face (below in an undescribed Chilean species). *Lower mesal paraocular area rather flattened. Facial fovea elongate, shallow, and about half as long as scape (or shorter) in male, deeper and much longer in female. Middle ocellus above orbital tangent (frontal view). Vertex convex.* Gena of variable width.

Pronotum, on dorsal margin, with rounded ridge laterally. Preepisternal groove well developed, extending below scrobe (weak in some undescribed species). *Pterostigma longer than prestigma, with middle area yellowish; side basal to vein r clearly diverging from costa; side within marginal cell curved (fig. 1).* Marginal cell (fig. 1) truncate at apex, slightly longer than distance from its apex to wing tip. *Two submarginal cells.* First submarginal cell longer than second (cell 2 = 2 + 3 according to Ruz, 1991). Second cell M (maximum length) shorter than first one. First recurrent vein not interstitial with first transverse cubital. Forewing with cu-v longer than 2nd abscissa M + Cu. Hind wing with cu-v about ¼ or ⅕ as long as second abscissa M + Cu (fig. 2). Basitarsus 1 somewhat more than 4 times longer than broad in male and more than twice as wide in female. Femur 2 of female basally with comb on ventral border not well defined. *Middle tibial spur of female almost as long as basitarsus 2, distally with fine, evenly spaced teeth (fig. 15); in male more than half as long as basitarsus 2 and with minute, fine, dense teeth.* Basitarsus 2 about as long as 1 and shorter than 3. Tibia 3 of female less than twice as long as basitarsus 3, with keirotrichia on most of inner surface except close to dorsal and ventral margins; *male with dorsal margin of tibia 3 serrate (fig. 12)*, with keirotrichia as in female. *Scopal hairs on tibia fine, apparently simple, rather sparse, somewhat longer than hairs at apex of metasoma, and bent toward their apices. Hind tibial spurs* with fine teeth; in male, outer one somewhat shorter than inner one and more curved toward apex; *in female* spurs subequal and *strongly curved at apex.* Basitibial plate of male well defined, with margins somewhat elevated, carinate. Tarsus 3 unmodified. Claws bifurcate, rather deeply cleft; rami subequal in male, inner shorter than outer in female.

T2 with lateral fovea extremely weak (absent in one undescribed Chilean species). Pygidial plate rounded at apex in female, absent in male except for small median glabrous area distally on T7. T8 of male trapezoidal. S5 and S6 with hairs short, appressed, and directed obliquely toward midline. S6 of male distally with rather large membranous area and V-shaped median emargination. S6 of female with basal margin straight, margin bordering apodeme strongly sclerotized, and lateral margin with strong curved ridge; distal margin slightly concave in middle; duplication (on dorsal side of sternum) membranous (see Michener, 1944; Ruz, 1991); exposed distal area of S6 basally with minute sparse hairs, which are longer and denser on premarginal area (especially dense laterally). S7 of male with two distal projections; proximal arms widely open. S8 of male with gradually tapered distal projection; body of sternum with strong longitudinal salient on dorsal surface (figs. 10, 11). Genital capsule with wide, inflexed gonocoxal apodeme; gonocoxites

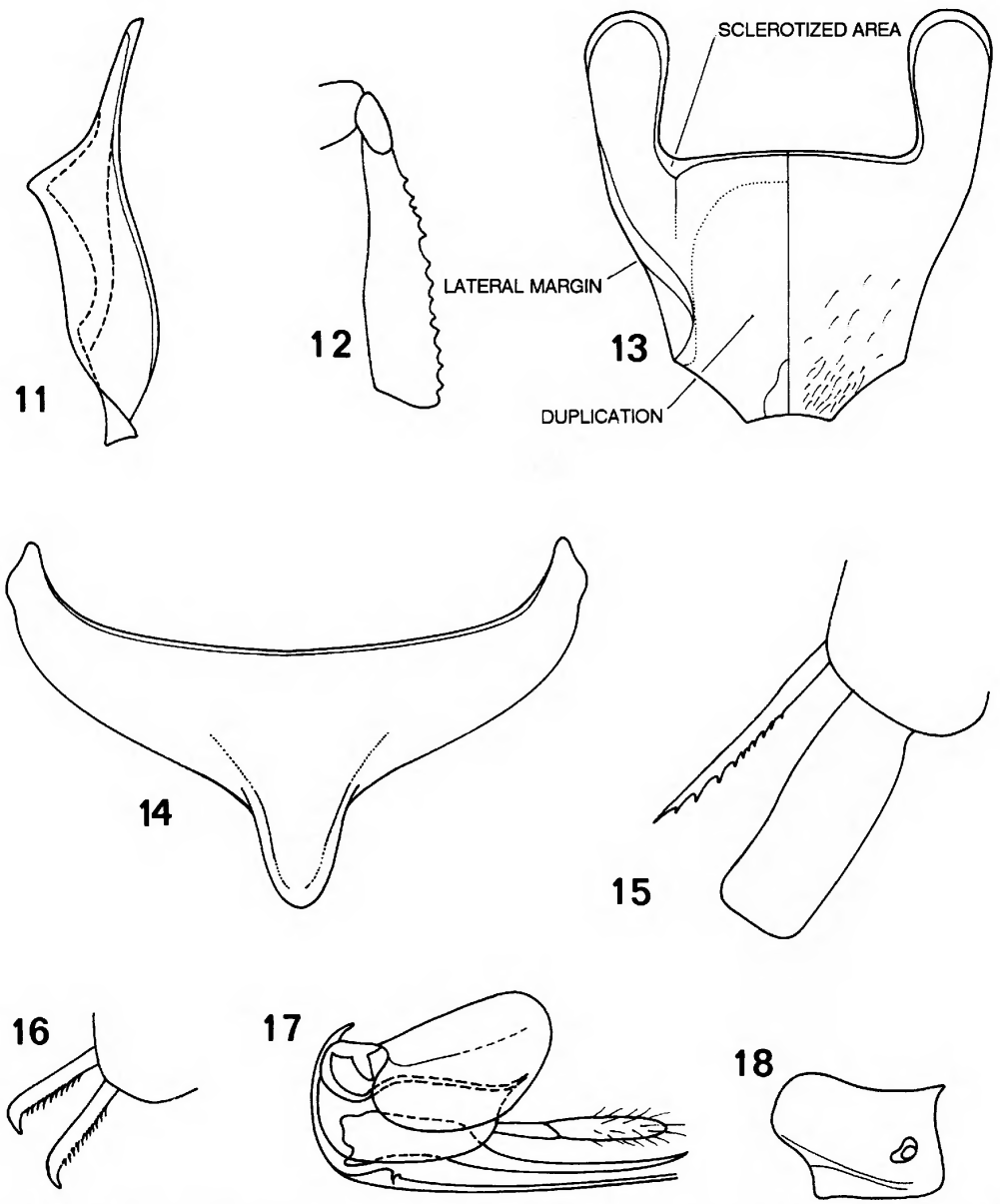


Figs. 1–10. *Parasarus atacamensis*, n. sp., male. **1, 2.** Forewing and hindwing. **3.** Labrum. **4.** Head, frontal view. **5.** S6, dorsal view left; ventral view right. **6.** Mouthparts. **7.** Head, lateral view. **8.** Genital capsule, dorsal view left; ventral view right. **9.** S7. **10.** S8, dorsal view left; ventral view right.

usually elongate, fused proximally only; gonostyli fused to gonocoxite, not articulated. Volsellae apparently free mesally, with denticles; penis valvae simple, acute distally, fused to each other and to membranous penis, except at apex. Sting elongate (slightly surpassing stylus), first valvula well sclerotized, valve present.

The species of this genus are distributed in northern Chile and in Catamarca Province, Argentina.

ETYMOLOGY: The prefix is from Greek



Figs. 11–18. *Parasarus atacamensis*, n. sp. Figs. 11, 12, male. **11.** S8, lateral view. **12.** Hind tibia. Figs. 13–18, female. **13.** S6, dorsal view left; ventral view right. **14.** T6. **15.** Middle tibial spur. **16.** Hind tibial spurs. **17.** Sting. **18.** T7 (= hemitergite).

meaning "akin to," and the stem has been used in the names of a number of presumably related genera.

Parasarus atacamensis Ruz, new species
Figures 1–18

DIAGNOSIS: Males can be recognized by the following: relatively dense pilosity on the lower half of face; metasomal sternum 2 (S2) apparently almost bare; S3–S5 clearly pilose laterally, with hairs slanting toward very well-delimited, glabrous midline area; integument generally areolate (dull on dorsal part of face); labrum with premarginal ridge which is laterally delimited by distinct clypeal projection; genitalia and associated sterna as illustrated. Females have a clypeus with a median longitudinal groove. In both sexes the lateral parts of the clypeus are somewhat concave.

DESCRIPTION: *MALE*. Length about 4 mm;

head width 1 mm; mesosoma width 1 mm; forewing length 3 mm. COLORATION. Black, with following parts yellow: ventral part of flagellum (dorsal part brown), base of mandible, apex of femur, outer surface of foretibia, apex of second and third tibia, basitarsus (other tarsomeres testaceous). Wings hyaline; tegula, veins, and stigma testaceous. PUBESCENCE. In general short, sparse, whitish and with tiny, almost invisible branches, denser on lower part of face (below antennal socket), sparse on scutum, scutellum, and postscutellum; hairs simple on distal fourth of labrum. Metasomal terga with very short, simple hairs; some sparse branched hairs on premarginal and lateral areas; hairs almost absent on T1; branched hairs becoming denser toward apex of metasoma. Metasomal sterna with fine hairs, but S3 and S6 each with group of lateral stiff hairs pointed toward glabrous mesal area, these hairs very short and very fine on S6. PUNCTATION. Head clearly areolate above antennal socket, with fine, somewhat shallow punctures irregularly distributed; lower part of head and gena almost smooth, shining, impunctate. Mesosomal integument like that of upper part of face, but punctures larger and sparser. Propodeal triangle finely striate basally; posterior part smooth, shining, impunctate; lateral parts sparsely punctate and slightly areolate. Metasoma smooth; terga finely and rather densely punctured, though punctures irregularly scattered, usually coarser on posterior terga than on anterior terga. Metasomal sterna weakly areolate, with fine punctures which tend to be deeper laterally toward apex. STRUCTURES. Head 1.2 times broader than long (42:34) (head width versus length varying from 1.2 to 1.5 times) (fig. 4). Labrum a little more than twice as broad as long (14:6), with ridge delimiting marginal area (fig. 3). Clypeus little more than twice as broad as long (23:11) (varying from 2.08 to 2.6 times broader than long). Facial fovea narrow, slightly longer than inner subantennal suture (0.5:0.4). Supraclypeal area scarcely produced between antennal sockets. Frontal line with a small protuberance at apex. Distance from inner orbit to antennal socket a little shorter than distance between sockets (5:8). Eye length varying from 0.75 to 0.65 of head length (fig. 7). Gena with maximum width narrower than eye in lateral view (8:11). Pterostigma twice as wide as prestigma (4:2). Marginal cell 1.1 times longer than distance from its apex to wing tip (22:20) (fig. 1). Basitibial plate narrowing slightly toward apex. Tibia 2 with spur shorter than basitarsus, finely serrate (fig. 12); tibia 3 with inner spur a little longer than outer one. Fovea of T2 weakly depressed. Pygidial plate absent. S6 weakly membranous distally, with small V-shaped emargination (fig. 5). S7 with distal processes triangular in shape, shorter than basal ones (fig. 9). Proximal half of S8 with longitudinal median carina ventrally, and strongly developed laminar process dorsally (figs. 10, 11). Genital capsule as illustrated (fig. 8).

FEMALE. Length about 5 mm; head width 2 mm; mesosomal width 2 mm; forewing length 3.5 mm. As described for male except: COLORATION. Black, with following parts yellow: anterior surface of foretibia, apex of middle tibia, and posterior basitarsus. Metasomal sterna brown. PUBESCENCE. Clypeal pubescence sparse. Labrum pubescent on apical half. Metasomal sterna with proximal part glabrous mesally; S5 with denser hairs distally; S6 densely pubescent laterally, mesal area apparently glabrous, but group of short, dense, yellow hairs apically on each side. STRUCTURES. Head width to length 46:37. Labrum width to length 15:9. Clypeus with median longitudinal sulcus; clypeal width to length 28:15. Facial fovea somewhat broader than that of male; its length to inner subantennal suture 11:0.5. Supraclypeal area prominent. Distance from inner orbits to antennal socket compared to distance between sockets 0.8:0.9. Genal width to eye width 11:10. Marginal cell length to distance from its apex to wing tip 23:18. Basitibial plate somewhat expanded distally. Middle tibial spur about as long as basitarsus, becoming more denticulate apically (fig. 15). Posterior tibial spurs subequal in length, their apices clearly curved (fig. 16). Lateral fovea of T2 larger than that of male, sometimes oblique, expanded distally. S5 with wide V-shaped emargination apically. S6 as in figure 13. Pygidial plate with longitudinal swollen ridge; apex narrowed and rounded (fig. 14). Sting and T7 as illustrated (figs. 17, 18).

Holotype male and allotype: Paipote, At-

acama Region, Chile, October 11, 1971 (J. G. Rozen and L. Peña); in the collection of the American Museum of Natural History.

Paratypes: **CHILE.**–ATACAMA: *Paipote*: 89♂, 22♀, X-15-1969, 3♂, 1♀, X-20-1971 , 4♂, 1♀, X-11-1971, 5♂, 1♀, X-12-1971 (all J. G. Rozen, L. Peña); 10♂, 2♀, X-10-1977 (V. Cabezas); same date: 1♂ (H. Flores), 16♂, 1♀ (J. C. Magunacelaya), 5♂ (L. Ruz), 10♂ (E. De La Hoz), 10♂ (H. Toro) and 4♂ (E. Balart). *Algarrobal* (Paipote): 5♂, X-11-1977; same date: 3♂, 2♀ (E. Balart), 1♂ (H. Flores), 1♀ (H. Toro). *Canto del Agua*: 14♂, 2♀, X-9-1977 (H. Flores); same date: 24♂ (J. C. Magunacelaya), 36♂, 8♀ (H. Toro), 8♂, 1♀ (E. Balart), 26♂, 6♀ (V. Cabezas); 150♂, 10♀, X-21-1969, 2♀, X-13-1971 (J. G. Rozen, L. Peña). *Caldera*: (14 km N) 46♂, 24♀, X-9-1971 (J. G. Rozen, L. Peña). *Copiapó*: (42 km S) 14♂, 4♀, X-19-1969 (J. G. Rozen, L. Peña); (44 km S) 4♂, 8♀, X-21-1971, (55 km S) 3♀, same date, (66 km S) 1♂, X-19-1971, (10–20 mi S), 1♂, X-18-1969 (all J. G. Rozen, L. Peña); (NW) 2♂, 1100 m, X-4-1980 (L. Peña); (100 km S) 4♂, X-1-1980 (L. Peña). *Between Copiapó and Juntas*: 7♂, 1♀, 1600 m, X-2,3-1980 (L. Peña). *Between Paipote and Las Juntas*: 12♂, 2♀, X-15-1969 (J. G. Rozen, L. Peña). *Las Juntas*: 13♂, 3♀, X-15-1969 (J. G. Rozen, L. Peña); 2♂, 1♀ (on Río Huasco), 1250 m X-27-1967 (L. Peña); 6♂, IX-1968 (E. De La Hoz); same date: 5♂ (H. Toro), 4♂ (E. Montenegro), 2♂ (L. Ruz). *Travesía*: 78♂, 5♀, X-1969, (H. Toro); same date: 4♂, 1♀, (G. Dazarola), 3♂ (E. Montenegro), 4♂, 2♀ (L. Ruz); 1♂, 1♀, X-11-1977 (H. Toro); same date: 2♂ (J. C. Magunacelaya), 2♂ (L. Ruz). *Vallenar* (10 km S): 6♂, X-13-1971 (J. G. Rozen, L. Peña); *Conai* (E. Vallenar): 12♂, X-25,26-1980 (L. Peña). *Q. Maitencillo* (SW of Vallenar): 1♂, X-11-1980 (L. Peña). *Pinte* (SE of Vallenar): 39♂, 16♀, 1600 m, X-25-1980 (L. Peña). *Vicinity of Freirina*: 4♂, 2♀, X-14-1969 (J. G. Rozen, L. Peña). *Obispito*: 1♀, X-17-1969 (J. G. Rozen, L. Peña).

COQUIMBO: *Llano de la Higuera*: (N of Tofo) 36♂, 32♀, X-14,15-1971 (J. G. Rozen, L. Peña); *Choros Bajos*: 16♂, 13♀, X-12-1977 (H. Flores); same date: 9♂, 1♀ (J. C. Magunacelaya), 7♂ (H. Toro), 2♂ (V. Cabezas), 3♂, 7♀ (E. Balart), 3♂ (E. De La Hoz) and 1♂, 1♀ (M. Rojas). *Los Choros*: 7♂, 22♀, II-2-1972 (L. Ruz); same date: 2♂, 8♀ (E. Montenegro), 1♀ (M. Pastén) and 1♀ (H. Flores). *Quebrada Los Choros*: 4♀, X-12-1977 (J. C. Magunacelaya); (Choros, Canyon, 10 km S Incahuasi) 1♂, 1♀, X-13-1969 (J. G. Rozen, L. Peña). *Carretera Panamericana al Norte de La Serena*: 2♂, 1970-72, Int. Biol. Program (A. Moldenke). *La Serena*: 2♀, X-29-1966 (R. W. H.). *Totoral*: 1♂, X-21-1980 (L. Peña). *Los Loritos* (N of Choros Bajos): 7♂, X-1983 (L. Peña). *Pangue*: (22 km S of Vicuña) 6♂, 7♀, X-16-1971 (J. G. Rozen, L. Peña).

VALPARAISO: Aconcagua Province: *Punta Molles*: 1♂, X-14-1977 (R.W.H.).

Most of the paratypes are deposited in the AMNH and UCV. Other paratypes will be deposited in the following collections: Museo Nacional de Historia Natural, Santiago, Chile; Snow Entomological Museum, University of Kansas, Lawrence, Kansas; Bee Biology and Systematics Laboratory, Utah State University, Logan; National Museum of Natural History, Washington, D.C.; the Museum of Natural History, London, England; Museum für Naturkunde der Humboldt Universität zu Berlin, Germany; Museo Argentino de Ciencias Naturales "Bernardino Rivadavia," Buenos Aires, Argentina.

COMMENTS: This species is highly variable, especially with respect to head width, clypeal width, length and position of eyes (from divergent above to more or less subparallel), integumental texture, and puncture density on head and scutum. Because of this variation, species boundaries are uncertain and therefore some specimens (in AMNH) collected near Vicuña, Elqui Province, Coquimbo Region, were not designated as paratypes. They might not be conspecific with those from the Atacama Region; however, there are no significant differences in the genitalia between them. Also, 67♂ and 24♀ from Pinte (SE Vallenar), Atacama Province, Chile (L. Peña) (in AMNH), were not designated paratypes because they lacked collection dates.

Individuals of both sexes of *P. atacamensis* have been found visiting the following plant species: *Baccharis paniculata, Gutierrezia taltalensis, Mesembrianthemum crystallinum*, and *Calandrinia* sp. Further host plant data are given in the section on Biology, below.

DISTRIBUTION: This species is found in northern Chile.

ETYMOLOGY: The specific name refers to

the Atacama Desert in Chile, where many specimens have been collected.

BIOLOGY

DESCRIPTION OF SITES: Nests of *Parasarus atacamensis* were encountered at three sites. Two nests, about 100 m apart, were discovered at 6 km south of Vicuña, Elqui Province, Chile, in October 1991. This area is pictured and characterized in Rozen (in prep. 1) and further discussed in Rozen (in prep. 2). As indicated in the Systematics section, specimens from this region differ from type specimens of this species, suggesting that Vicuña material may eventually be found to be nonconspecific. Most information about nesting biology comes from this site.

Both nests were composite, being used by a number of females. One, excavated on October 19, 1991, was in rather sandy soil (faintly moist at the cell level) on a nearly horizontal shoulder of an unpaved road. Four females as well as a single female of *Kelita tuberculata* Ehrenfeld and Rozen were collected from it before it was dissected. JGR unsuccessfully attempted to excavate the other nest (on a mostly unshaded surface, sloping about 20°) in November after it had become dormant. Notes below refer only to the nest studied in October. At this locality, females bearing pollen were collected from *Alona filifolia* and *Pleurophora pungens*.[3] Because the color of the pollen carried by females from the two plants was plant specific, there is little doubt that both plant species are used for larval food.

A single nest of *Parasarus atacamensis* was also examined at 28 mi south of Copiapó, Copiapó Province, Chile (a site within the known range of typical *P. atacamensis*), alongside a paved highway on October 20, 1969. Numerous apparent exit holes occurring near the nest entrance as well as an abundance of both males and females on the flowers suggested that other nests were present. The nest entrance, on horizontal ground, was at the base of a low-growing succulent plant with small yellow flowers. This plant, which was not identified and which grew for about 10 m next to the shoulder of the road, was the food source at this locality. Soil of very fine, dry silt containing numerous large rocks was faintly moist at the cell level. The nest area was unshaded except for the low-growing pollen plant. Only one female seemed to be associated with this nest, as was also suggested by the single open cell.

The third nesting site, consisting of a single nest among nests of *Liphanthus alicahue* Ruz and Toro at Paipote, Copiapó Province, was mentioned in Ehrenfeld and Rozen (1977) and Rozen (1989). When it was excavated on October 20, 1972, the only significant information noted was the apparent association of *Kelita tuberculata* as a nest parasite of *Parasarus*.

NEST ARCHITECTURE: The two nests studied (from near Vicuña and near Copiapó) were similar. Both had simple entrances, without tumuli, about 2.0 mm diameter. In each, the main tunnel meandered downward. The main tunnel of the nest from Vicuña remained open its entire length and descended along a crack at first so that its diameter did not become constant until it reached a depth of 8–9 cm. Cells were arranged in all directions from the burrow and were connected to it by filled laterals, some of which ranged in length from 4.5 to 6 cm. These cells were found at depths from 13 to 16 cm, and some may have been even deeper.

The main tunnel from the Copiapó nest remained at a diameter of 2 mm and was plugged with loose fill 4 to 8 cm down. At 8 cm the tunnel divided, with one branch ending several cm away and the other one meandering mostly horizontally for 11 cm. The latter branch opened into a cell that was being provisioned. Three complete cells, all at about 10 cm in depth, were closely associated with the open one and were connected to the open burrow by filled laterals. Hence this nest was somewhat shallower and tended to extend farther laterally than the other.

Arranged singly, cells of both nests were nearly horizontal, tilting at most 10 to 20° toward the rear. The entrance diameter of a cell from each nest was 2.0 mm. Cell dimensions at the Vicuña site were 4.7–5.2 mm long and 2.7–2.8 mm in maximum diameter (N

[3] Plants kindly identified by C. Marticorena and M. Quezada, Departamento de Botánica, Universidad de Concepción, Chile.

= 3); at the Copiapó site, 5.0–5.5 mm long and 2.2–2.7 mm in maximum diameter (N = 3). One cell from Vicuña may have had a slightly flatter floor than ceiling, but cells from Copiapó appeared symmetrical around their long axes. Cells from both sites were normally round at the rear and, in other ways, unremarkable in shape. On the Copiapó samples, surfaces of cell walls were smooth and only faintly shiny. Droplets of water placed at various points on the wall indicated that the rear and floor were waterproof, but the ceiling near the cell entrance readily absorbed droplets. Beneath the waterproof, transparent lining, the cell wall may have been composed of a very thin layer of specially worked soil in the Copiapó material, but this layer was not noticed in the Vicuña material. At least at Vicuña, cell walls were slightly harder than the substrate. All cell closures were concave spirals on the inside with three to four coils. A closure from Vicuña (but probably characteristic of all closures) clearly revealed a concave, rather smooth outer surface, with a closure thickness of 2 mm at the periphery and approximately 0.5 mm at the center, as seen in cross section. Loose soil had filled the lateral leading to the closure.

PROVISIONING AND DEVELOPMENT: Pollen was transported in a distinctly moist condition on the anterior surfaces of the female's hind tibiae. Completed food masses at both sites were flattened spheres. Those at Copiapó were 1.6–1.7 mm high (N = 3) and 2.1–2.3 mm (N = 2) in maximum diameter. The mass was mealy-moist throughout and placed about 0.5 mm from the rear of the cell. It was not "glued" to the cell floor by secretions or nectar, and it was not coated either by a waterproof covering or a layer of nectar. Provisions in an open cell at Copiapó indicate that food loads from foraging trips are stored first as paired irregular masses at the rear of the cell rather than as a single shaped small mass as is the case with some of the more specialized panurgines. Because females were gathering pollen from two species of plants in the Vicuña area, this species does not appear to be narrowly oligolectic. Another female bearing moist pollen was collected on *Calandrinia* at Puquios, Copiapó Province, on October 24, 1991, further suggesting that the species may have broad pollen preferences, as is also suggested by host labels on adult specimens (above).

Eggs, found only in the Copiapó nest, were placed on top of the flattened food spheres parallel to the long axis of the cell. Shiny, white, with a smooth chorion, the egg was slightly arched and touched the food mass at both ends. Two eggs measured 1.35 mm long and 0.7 mm in maximum diameter. The posterior end, toward the rear of the cell, was somewhat more pointed than the rounded anterior end. The single larva observed at Copiapó rested on top of the provisions and ate the food beneath its head; it was unable to crawl. Small larvae from Vicuña were found in the same position. One cell from there, with feces plastered on the rear of the cell as a single concave mass, contained an actively moving postdefecating larva. Another cell with feces in the same position was empty, suggesting either that the occupant of the cell had been of the same generation as its larval nest mates but had already matured, or that the nest was being used by more than one generation. Pupal structures were developing in at least one of the postdefecating larvae and in several of the predefecating larvae, indicating that the larvae were nearing pupation. Hence the species probably has more than one generation per year.

ADULT ACTIVITY: Males flew actively around the flowers at both sites and were presumably searching for mates.

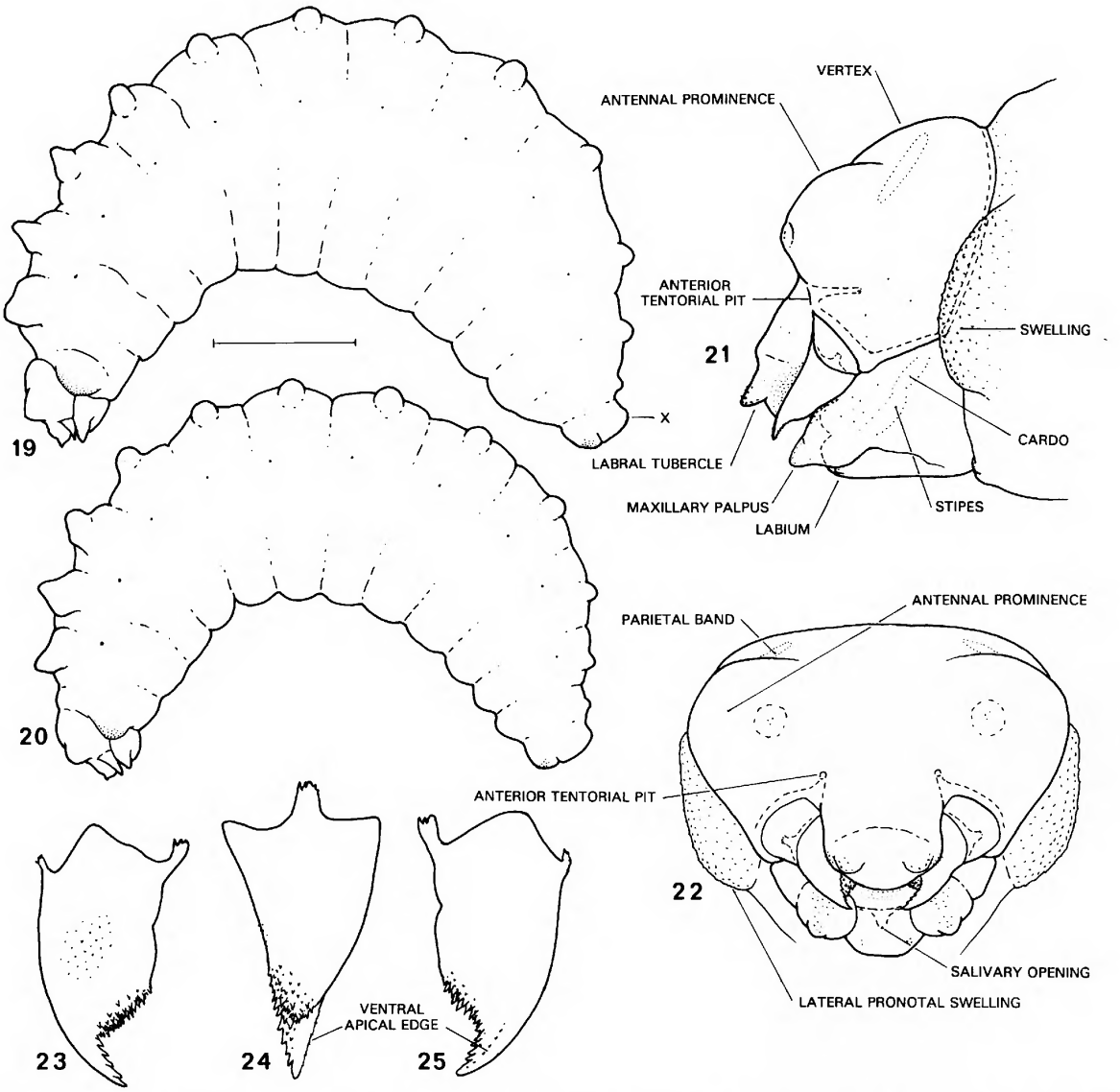
PARASITISM: Rozen (in prep. 2) definitely associated *Kelita tuberculata* with *Parasarus atacamensis* at the Vicuña site and tentatively at Paipote. In addition, several partly to fully grown meloid larvae were found in the nest at Vicuña.

MATURE LARVA

Figures 19–25

DIAGNOSIS: References to descriptions of mature larvae of other panurgines can be found in McGinley (1988).

The mature larvae of this species resemble larvae of *Protandrena, Pseudopanurgus*, and *Pterosarus* in that they possess well-developed maxillae and large maxillary palpi and a strongly recessed labial region. They also exhibit somewhat forward projecting dorsal thoracic tubercles as described below and,



Figs. 19–25. *Parasarus atacamensis*, n. sp., mature larva. **19.** Predefecating larva, lateral view. **20.** Postdefecating larva, lateral view. **21.** Head, lateral view. **22.** Head, frontal view. **23–25.** Right mandible, dorsal, adoral, and ventral views, respectively. Scale (= 1.0 mm) refers to figures 19 and 20.

with the exception of *Protandrena*, small spiracles, the atria of which do not project above the body wall. However, this species can be distinguished from the few species in these other genera whose larvae are known in that its mandible is serrate along the lower apical edge (also true for *Protandrena*), and the mandible does not appear to bear a subapical tooth larger than other teeth along the dorsal apical edge.[4] The greatly enlarged, globose antennal prominences in conjunction with the curved vertex as seen in lateral view

[4] The mandible may actually possess a subapical tooth on the dorsal apical edge homologous with the subapical tooth of *Protandrena, Pseudopanurgus,* and *Pterosarus.* However, because the teeth on the mandible are large (relative to mandible size), many of the teeth along the dorsal apical edge appear equally large.

(fig. 21) is unique to *Parasarus*, so far as is known now. While larvae of these other genera have somewhat projecting antennal prominences, they are not as globose as those of *Parasarus* and their vertices tend to be angled or projecting as seen from the side. The larva of this species should be compared with larvae of *Heterosarus, Xenopanurgus, Pseudosarus, Rhophitulus, Chaeturginus, Cephalurgus, Metapsaenythia,* and *Anthemurgus*, which have yet to be described. This assemblage, including *Parasarus*, is a largely unresolved clade in the Panurginae according to Ruz (1986).

Characters that are particularly helpful in distinguishing mature larvae of *Parasarus atacamensis* from those of other panurgines are presented in italics.

HEAD (figs. 21, 22): Integument of head capsule with very few sensilla, which are not setiform; sensilla of mouthparts also not setiform; integument of both pre- and postdefecating larvae unpigmented except for mandibular apices.

Head size moderate in relationship to rest of body of postdefecating larva; head capsule much wider than maximum length from vertex to lower clypeal margin. Tentorium including dorsal arms well developed; anterior pits in normal position on face; posterior tentorial pit normal in position; posterior thickening of head capsule well developed, only slightly curving forward medially as seen in dorsal view; posterior margin of head capsule normal in position; median longitudinal thickening of head capsule absent; hypostomal ridge well developed, without ramus; pleurostomal ridge well developed; epistomal ridge well developed between anterior mandibular articulations and anterior tentorial pits, absent mesad of these pits; epistomal depression moderately pronounced between pits. Parietal bands distinct though hidden in frontal view (fig. 22) by enlarged antennal prominences. *Antennal prominences very strongly developed, globose*; antennal disc and papilla moderate in size, with three sensilla. *Vertex in lateral view (fig. 21) evenly rounded, without projections or elevations and, by contrast, accentuating large antennal prominences*; frontoclypeal area normal in length and configuration, not projecting strongly, as characteristic of *Panurgus*. Labrum normal in size and shape for Panurginae, without sclerite; paired labral tubercles arising from labral disc, large; epipharynx spiculate laterally.

Mandible (figs. 23–25) moderately slender; dorsal mandibular spiculation very fine, sharp-pointed, nonsetiform; outer surface without tubercle; *apex* tapering, slender, *simple (i.e., with subapical tooth subequal in size to other teeth on dorsal apical edge; ventral apical edge with distinct serrations*; cusp moderately strongly produced, with moderately large, evenly spaced teeth, not produced ventrally as in *Panurgus* and without large cuspal tooth as in *Melitturga*. Labiomaxillary region recessed, and, except for maxillary apices, fused. *Maxilla as seen in lateral view (fig. 21) projecting well beyond labial apex*; cardo and stipes represented as unpigmented, vague integumental thickening (best seen on cleared specimen); articulating arm of stipital sclerite perhaps evident on sides of hypopharyngeal groove; *palpus large, at least as large as labral tubercle, not directed downward* as in *Panurginus*; dorsal surface of maxilla spiculate, with some spicules extending onto dorsal surface of maxilla. Labium not divided into prementum and postmentum; premental sclerite not evident; labral apex recessed by comparison with maxillary apices, unlike those in *Camptopoeum*; labial palpus only vaguely represented as slight swelling, much smaller than maxillary palpus. *Salivary opening in weakly expressed, curved groove.* Hypopharynx slightly bulging but well recessed under labrum, spiculate.

BODY: Integument without obvious setae; dorsally integument not spiculate; ventrally most segments with small, widely spaced, fine spicules, except *posteroventral area on abdominal segment X with band of large spicules; lateral pronotal swelling strongly spiculate.* Body form (figs. 19, 20) moderately robust; intersegmental lines only moderately incised on pre- and postdefecating larvae; intrasegmental lines not evident; paired dorsal body tubercles (figs. 19, 20) moderately small; *dorsal prothoracic tubercles apically somewhat forward projecting; meso- and metathoracic dorsal tubercles subapically somewhat forward projecting; hence thoracic tubercles*

similar to those of Protandrena, Pterosarus, Pseudopanurgus, Melitturga, but unlike those of Meliturgula, Camptopoeum, Panurgus, most Calliopsis (sensu Ruz, 1991), and Panurginus; dorsal abdominal tubercles rounded (i.e., not transverse), nonspiculate, but arising abruptly from each segment, hence well defined; prothorax (figs. 19–22) with pair of lateral swellings that are strongly spiculate,[5] suggestive of prothoracic flaps of *Camptopoeum* (Rozen, 1988: figs. 5–7) except not so flat; pleural region elsewhere not produced; only abdominal segment X without paired tubercles; *segment X with dorsal surface somewhat elevated as seen in lateral view (figs. 19, 20)*; segment X attached centrally to IX, not produced posteriorly or ventrally. *Spiracles extremely small, unpigmented, virtually impossible to detect on uncleared specimen under normal magnification*; anterior spiracles somewhat larger than posterior ones; peritreme not certainly present; *atrium not projecting above body wall*, globose, without rim, apparently unornamented; primary tracheal opening with collar; subatrium of moderate length, consisting of approximately 10 chambers; in general spiracle, except for nongrooved atrial wall, similar to that of *Pterosarus boylei* (Cockerell) (Rozen, 1966: fig. 4). Male sex characters consisting of pale, transverse, dumbbell-shaped imaginal disc in middle of venter of abdominal segment IX; female sex characters, paired paramedian, pale imaginal discs on venter of abdominal segments VII, VIII, and IX; those of segment VII farthest apart, those of IX closest together.

MATERIAL STUDIED: 4 predefecating, 2 postdefecating, nondiapausing larvae, 6 km south of Vicuña, Elqui Province, Chile, October 19, 1991 (J. G. Rozen).

[5] Cursory examination of larvae of a number of panurgine taxa suggests that spiculate lateral prothoracic lobes immediately behind the head may have been overlooked in previous treatments of panurgine larvae. This feature seems variably developed in different taxa and should be addressed in future descriptions.

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